



US005986330A

United States Patent [19]

Kalnitsky et al.

[11] Patent Number: 5,986,330
[45] Date of Patent: Nov. 16, 1999

[54] ENHANCED PLANARIZATION TECHNIQUE FOR AN INTEGRATED CIRCUIT

[75] Inventors: Alex Kalnitsky, Grenoble, France;
Yih-Shung Lin, Plano, Tex.

[73] Assignee: STMicroelectronics, Inc., Carrollton, Tex.

[21] Appl. No.: 09/007,668

[22] Filed: Jan. 15, 1998

Related U.S. Application Data

[63] Continuation of application No. 08/456,343, Jun. 1, 1995, abandoned, which is a continuation of application No. 08/163,043, Dec. 6, 1993, Pat. No. 5,435,888.

[51] Int. Cl.⁶ H01L 23/58

[52] U.S. Cl. 257/644; 257/647; 257/634

[58] Field of Search 257/644, 647, 257/634

[56] References Cited

U.S. PATENT DOCUMENTS

4,253,907	3/1981	Parry et al.	156/643
4,354,896	10/1982	Hunter	156/643
4,384,938	5/1983	Desilets et al.	204/298
4,654,112	3/1987	Douglas et al.	156/643
4,657,628	4/1987	Holloway et al.	156/643

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

2083948A	3/1982	European Pat. Off.
0111706	6/1984	European Pat. Off.
0265638	5/1988	European Pat. Off.
327 412	8/1989	European Pat. Off.
0185787	1/1992	European Pat. Off.
0491408	6/1992	European Pat. Off.
410244	1/1991	Germany
60-58635	4/1985	Japan
61-26240	2/1986	Japan
61-232646	10/1986	Japan
62-106645	4/1987	Japan

63-293946	11/1988	Japan
4092453	3/1992	Japan
2167901A	4/1986	United Kingdom
8901236	5/1992	United Kingdom

OTHER PUBLICATIONS

IBM Technical Disclosure Bulletin, vol. 30, No. 8, p. 252, Jan. 1988.

IBM Technical Disclosure Bulletin, vol. 29, No. 3, p. 1328, Aug. 1986.

"A New Technology for Oxide Contact and Via Etch", by Pete Singer, Semiconductor International, p. 36 (1993).

Handbook on Semiconductors, (ed. C. Holson), vol. 4, p. 208 (1981).

"Etching Applications and Trends of Dry Etching", Ephrath et al., Semiconductor Technology and Computer Systems, Ch. 2, p. 26. 1991.

VLSI Electronics Microstructures Science, vol. 8, ed. Norman Einspruch, p. 298 (1984).

"Plasma Etch Anisotropy", C.B. Zarowin, J. Electrochem. Soc., Solid-State Science and Technology, p. 1144 (1983).

"A Super Self-Aligned Source/Drain MOSFET," Lau et al., IEDM, p. 358 (1987).

"A Margin-Free Contact Process Using an Al₂O₃ Etch-Stop Layer for High Density Devices", Fukase et al., IEDM, p. 837 (1992).

Research Disclosure No. 282, Oct. 1987, Havant GB p. 608, "Spin on Glass Insulator Enhancement".

"Etching—Applications and Trends of Dry Etching", by L.M. Ephrath and G.S. Mathad, Handbook of Advanced Technology and Computer Systems at 27 ff (1988).

(List continued on next page.)

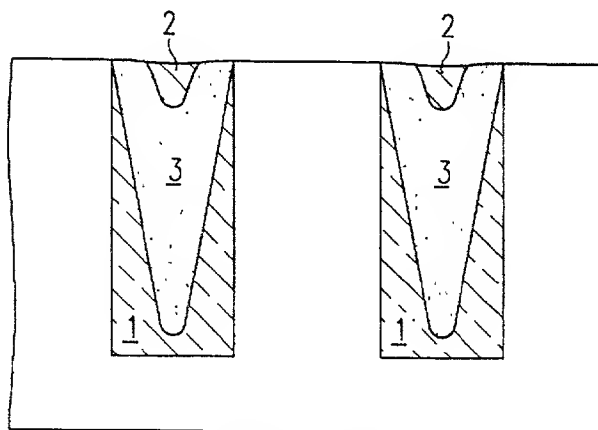
Primary Examiner—Stephen D. Meier

Attorney, Agent, or Firm—Theodore E. Galanthay; Lisa K. Jorgenson

[57] ABSTRACT

A method for planarizing integrated circuit topographies, wherein, after a first layer of spin-on glass is deposited, a layer of low-temperature oxide is deposited before a second layer of spin-on glass.

22 Claims, 4 Drawing Sheets



SOG/LTO etchback

U.S. PATENT DOCUMENTS

4,660,278	4/1987	Teng	29/576
4,676,867	6/1987	Elkins et al. .	
4,707,218	11/1987	Giammarco et al.	156/643
4,721,548	1/1988	Morimoto .	
4,755,476	7/1988	Bohm et al.	437/31
4,792,534	12/1988	Tsuji et al.	437/229
4,801,350	1/1989	Mattox et al.	156/643
4,801,560	1/1989	Wood et al.	437/195
4,824,767	4/1989	Chambers et al.	430/313
4,894,351	1/1990	Batty	437/190
4,912,061	3/1990	Nasr et al.	437/44
4,962,414	10/1990	Liou et al.	357/71
4,986,878	1/1991	Malazgirt et al.	156/643
5,003,062	3/1991	Yen	437/231
5,063,176	11/1991	Lee et al.	437/195
5,068,711	11/1991	Mise	257/752
5,110,763	5/1992	Matsumoto .	
5,117,273	5/1992	Stark et al.	357/54
5,158,910	10/1992	Cooper et al.	437/195
5,166,088	11/1992	Ueda et al.	437/47
5,244,841	9/1993	Marks et al.	437/228
5,250,472	10/1993	Chen et al. .	
5,266,525	11/1993	Morozumi	437/195
5,310,720	5/1994	Shin et al.	437/231
5,320,983	6/1994	Ouellet et al. .	
5,435,888	7/1995	Kalnitsky et al. .	
5,534,731	7/1996	Cheung	257/752

OTHER PUBLICATIONS

- "Reactive Ion Etching", by B. Gorowitz and R. Saia, 8 VLSI Electronics, 297ff (1984).
- Patent Abstracts of Japan, vol. 15, No. 348 (E-1107) Sep. 4, 1991 & JP-A-31 33 131 (Mitsubishi Electric Corp.) Jun. 6, 1991.
- "Three 'Low Dt' Options for Planarizing the Premetal Dielectric on an Advanced Double Poly BiCMOS Process", by W. Dauksher, M. Miller, and C. Tracey, J. Electrochem. Soc., vol. 139, No. 2, p. 532 (1992).
- "The Effect of Plasma Cure Temperature on Spin-On Glass", by H. Namatsu and K. Minegishi, J. Electrochem. Soc., vol. 140, No. 4, p. 140 (1991).
- "Hot-Carrier Aging of the MOS Transistor in the Presence of Spin-On Glass as the Interlevel Dielectric", by N. Lifschitz and G. Smolinsky, IEEE Electron Device Letters, vol. 12, No. 3, p. 140 (1991).
- "Advantages of Using Spin on Glass Layer in Interconnection Dielectric Planarization", Microelectronic Engineering, vol. 5 (1986).
- "Doped Silicon Oxide Deposition by Atmospheric Pressure and Low Temperature Chemical Vapor Deposition Using Tetraethoxysilane and Ozone", Fujino et al., J. Electrochem. Society, vol. 138, No. 10, p. 3019 Oct. 1991.
- "Polysilicon Planarization Using Spin-On Glass", S. Ramaswami and A. Nagy, J. Electrochem. Soc., vol. 139, No. 2, p. 591 (1992).